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## PROGRESS IN CHEMICAL GORSE CONTROL

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### INTRODUCTION

Gorse or Irish furze (*Ulex europaeus*) is a grey-green leguminous shrub with showy yellow-orange flowers and long, sharp spine-like reduced leaves. It grows best in well-drained but moist soils in a mild, cool environment at elevations above 3,000 feet and is concentrated in the Olinda-Kula region of Maui, although it also occurs on Hawaii. It fixes nitrogen in the soil (4) and is tolerant of fairly acid conditions and low fertility. Gorse was introduced to the Islands from Europe during the late 19th century as a fence-row plant for sheep ranching and had become a pest by 1920 (8).

The gorse plant produces seed in prolific numbers in pods which rupture along the dorsal suture when dry, propelling the seeds for distances as great as 10 or 15 feet. Estimates of the numbers of seeds in the soil under a mature stand of gorse vary from a few thousand to 10 or 15 thousand per square foot in the surface three inches. The seed of gorse, like most legumes, has an indurate seed coat which inhibits germination of fresh seeds (0-2 percent) and allows the seed to remain viable though dormant in the soil for periods of time up to 25 years or until the seed coat is scarified. Experimental plantings under favorable conditions have shown no seedling emergence in nine years (3).

The combination of a durable, viable seed and a deceptively slow initial spread has allowed the plant to become a serious pest on several thousand acres of land. Most of these acres have a reservoir of seeds in the soil that will require a control program of a very thorough nature, carefully executed for a period of 20 years or more. These facts of the life-cycle of the gorse plant make it apparent that the major need for control is a method that will bring about control of seeds while in the soil or of seedling plants before they reach the reproductive stage. Current research is directed toward this end.

\* Formerly known as *Progress Notes*.

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## CURRENT STATUS OF USEFUL TECHNIQUES

### *Fire*

The gorse plant is easily killed by a number of methods. It may be burned either with or without diesel oil or other fire carrier. Gorse itself contains a volatile oil that aids in its combustion if ignited on a sufficiently dry day. Relative humidity should be below 50 percent, however, for a high degree of kill. A light burn results in survival of the main gorse stems which begin regrowth almost immediately (3) but the young regrowth is much more easily killed with chemicals than are aged plants. Fires are usually not hot enough to kill more than a few of the seeds in the surface of the soil unless the plant is cut or bulldozed into piles and then burned. Burning is reported to crack the hard seed coat resulting in increased germination of gorse seeds accumulated in the soil. The combined effect of removal of the shading over-story of mature plants and the increased seed germination is usually a thick stand of young plants in the first season following fire.

### *Mechanical*

Removal of gorse by mechanical methods is expensive and no more effective than burning since only the mature plants are killed. Rakes and blades of various kinds have been tried in various parts of the world and are successful only as temporary measures where fire cannot be used. Hand methods have also been used and presumably the newer rotary type of brush mower would be equally useful and cheaper. Where tillage of the soil is possible, two or more years of cropping will give reasonable initial control. Bulldozing of gorse into windrows, burning and chemically controlling border plants are practiced in that sequence. Fertilization of pastures in gorse-infested areas (3) aids control by improving the competitive vigor of the forages.

### *Chemical*

A number of chemical methods have been tested in the Islands and in other parts of the world and while many are effective, none give 100percent control with a single application.

2,4,5-T. The hormone sprays were among the first used, and of these 2,4,5-T has proved the most effective. It is usually applied as a drench spray on the foliage at a dilution of 50 to 1 in oil or water at a rate of 3 pounds acid-equivalent per acre. Basal application is not used because the stands of the shrub are usually impossible to penetrate except with very heavy equipment. Aerial applications of this material are used extensively in New Zealand and Australia (2, 5). 2,4,5-T has been shown to be effective for treatment of Island stands and combination hormone sprays are

about equally effective (9). Several local ranches use this method routinely at present.

*2,4-D.* Gorse is resistant to foliage application of 2,4-D alone but is reported (7) to be moderately sensitive to basal spray. When hand methods are used for removal, painting the stump with undiluted 2,4-D gives good control (3).

*Ammate.* Ammonium sulfamate (Ammate) is a water-soluble chemical used frequently and successfully in many places on the Mainland. Work on the coast of Oregon (3) has shown it to give the best control of a large number of chemicals tested. It is applied at rates of 3 pounds per acre and usually two or three applications are required for complete control. As is true with the hormone sprays, Ammate removes only the mature plants and the numerous seeds in the soil will continue to produce young plants for many years following even a thorough removal of mature plants. Ammate is corrosive to equipment but can be used near crops sensitive to the hormone sprays. This is probably the cheapest chemical method for killing mature gorse plants.

*CMU - Derivatives.* "Monuron" (3-p-chlorophenyl-1, 1-dimethylurea) and several related compounds are classed as soil "sterilants" and are used also for pre-emergence weed control in sugar cane and pineapple. At higher rates of application, they are used to remove all vegetation around industrial installations and in roadways, fences and power lines, and public areas. At rates above 80 pounds per acre this chemical was found to give excellent control of gorse in the Olinda area on Maui.

"Fenuron" (3-(phenyl)-1, 1-dimethylurea) has also shown promise in brush control (1) and may prove to be effective for controlling gorse.

## RESULTS OF EXPERIMENTAL APPLICATIONS

Table 1 shows the relative gorse control with three chemicals of the sterilant type at Olinda, Maui.

TABLE 1. Percentage reduction in aerial cover of live gorse plant 15 months following treatment with three chemicals at three rates

Rate (Pounds per acre, active)	Cover reduction (percent)		
	TBA <sup>1/</sup>	CMU <sup>2/</sup>	CMU-TCA <sup>3/</sup>
85	—	97	—
45	0	55	97
25	—	23	86

<sup>1/</sup> TBA is Trichlorobenzoic acid of a formulation manufactured by American Chemical Paint Company.

<sup>2/</sup> CMU is the usual Dupont "Monuron" (see name above) pelleted for experimental use by the Filtrol Corporation, Los Angeles.

<sup>3/</sup> CMU-TCA is 3 (p-Chlorophenyl)-1, 1-dimethylurea trichloroacetate, a granular material manufactured by Allied Chemical and Dye Corporation as "Urox".

The treatment with "Monuron" at 85 pounds per acre gave essentially a 100 percent kill (except for a slight "border effect") of gorse but allowed good survival of the major forage grasses and some other plants in the Olinda area. Plants classed as being relatively little affected by this rate of chemical were: orchard grass (*Dactylis glomerata*), rattail grass (*Sporobolus capensis*), sweet vernal grass (*Anthoxanthum odoratum*), velvet grass (*Holcus lanatus*), manienie (*Cynodon dactylon*), plantain (*Plantago major*), blackberry (*Rubus* sp.), and a few others. Rattail and manienie were burned to a noticeable degree soon after treatment especially in places where drainage was especially good but both recovered.

The competition afforded by a vigorous cover of non-noxious plants is one of the best aids to gorse control.

In addition to the large plot tests of "Monuron", "Urox", and TBA, the "Urox" treatment which seems to be most effective, was applied as a spot treatment on scattered individual plants. The reduction in living plant cover is reported for three rates of application on an individual plant and on a small area (50 square feet). The reduction in cover or apparent kill on these few trials is shown in table 2 as means of duplicate plots. Although insufficient replication of these tests was used for statistical evaluation of the result, it appears that this form of application is in general less successful than application over the larger area of the 1,000-square-foot plots. This is in part attributable to the fact that the gorse is the dominant plant in its community and exercises this dominance in uptake of this root-absorbed herbicide. When the chemical is applied on an area smaller than the average root-volume diameter, only a portion of the root system is affected and a large portion of the active root system is untouched, thus being able to carry on normal water and nutrient uptake. The rate of the applied chemical is thus not a critical factor until the area covered by the herbicide includes the entire soil area in which the plant roots are actively "feeding". This principle of herbicidal activity can probably be applied in general to the root-absorbed chemicals and may account for the observed selectivity of some of the "sterilant" class of herbicidal chemicals. Experiments on guava, lantana, and other dominant shrubs to be reported later tend to bear out this hypothesis.

TABLE 2. Cover reduction of gorse treated with CMU-TCA at three rates on a small-unit basis

Rate applied (lbs./acre)	Cover reduction per 50 sq. ft. (percent)	Rate applied (lbs./plant)	Cover reduction per plant (percent)
100	45	1/8	65
200	70	1/4	95
400	70	1/2	85

Seeds of gorse were screened from the soil of a plot treated with 85 pounds of "Monuron" and from control areas and were germinated to determine any residual effect of the chemical 16 months after application. Ten replicates of 100 seeds each were germinated on moist filter paper in petri dishes in the laboratory.

Table 3 shows the results of the germinations of seeds from the two sources.

TABLE 3. Germination and hard seed content of gorse seed screened from CMU-treated (85 pounds per acre) and control plots

	Germination (percent)	Hard seed (percent)	Total (percent)
Control	1.0	94.1	95.1
CMU	3.6	81.7	85.3
Difference	2.6	12.4	9.8

The CMU treatment more than tripled the germination of gorse seed and decreased the remaining hard seeds, both differences being significant beyond the 1 percent level. Although the plots were destroyed before the fate of the germinated seedlings could be followed in the field, it is known from the literature that other legume seedlings are frequently killed as soon as the root elongates far enough to contact the chemical (6). Even without killing the seedlings directly, however, the increased rate of germination would shorten the amount of time a control program needs to be carried on. The total germination percentage was reduced in this laboratory test (9.8 percent) primarily by the number of seeds which imbibed water and swelled but failed to germinate. These invariably either died from chemical effects and molded or from primary mold infestations. The total effect was to stimulate germination but reduce the remaining viable seed reservoir by more than 10 percent.

No careful evaluation of cost of these chemicals can be made at present since eradication of the pest requires elimination of the young plants that will continue to germinate for many years. The efficiency of chemicals for gorse control will depend, in the last analysis, on their prevention of reinfestation either by killing seed in the soil or by killing seedlings as soon as they emerge. None of the test chemicals will do this completely as yet; so that the best answer to the problem remains one of a program of control consistently applied for a number of years.

## SUMMARY

A number of new chemical treatments were used experimentally to determine their effectiveness in gorse control. "Monuron" (3-p-chlorophenyl-1, 1 dimethylurea) and related compounds gave essentially 100 percent kill of gorse. On large plot tests "Urox" proved to be most effective. CMU treatments more than tripled the germination of gorse seed.

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